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**CARDINAL DIVIDE AREA BASELINE SURVEY
WATER QUALITY AND AQUATIC BIOTA
1995-96**

DATA REPORT

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1.0 INTRODUCTION

In view of potential coal mine development in the Mountain Park area of the upper McLeod River and upper Cardinal River basins, Alberta Environmental Protection carried out a one year sampling program to obtain baseline data on water quality and benthos in the project area which would serve to complement and corroborate data being collected by the proponent. This report provides basic information on the methods used and compiles the data obtained during the program.

2.0 METHODS - GENERAL

Seasonal surveys were carried out from June 1995 to January 1996 inclusive, at eight sites in the area (Figure 1, Table 1). Sampling was done for 'conventional' water quality variables, 'trace organic' variables, benthic algae (epilithic chlorophyll *a*), and zoobenthos, although not all variables were sampled at every site on every occasion. Most water quality analyses were done at the Alberta Environmental Centre, Vegreville. Epilithic chlorophyll analyses were done at the McIntyre Centre, Monitoring Branch, AEP, and zoobenthic analyses were done by Dr. Emil Dratnal, Calgary. Details on the specific methods of collection and analysis are available from Water Management Division, AEP.

3.0 RESULTS

Table 2 contains data for 'conventional' water quality variables, including temperature, oxygen, major ions and related variables, metals, nutrients, organics, and indicator bacteria. Extractable 'priority pollutants' were analyzed for selected sites and are compiled in Table 3 (none were detected). The amount of algae on streambed rocks (epilithic) was estimated by analyzing the chlorophyll *a* content in samples scraped from defined areas on representative rocks from sampling sites. The chlorophyll values are compiled in Table 4. Samples for zoobenthos counts and identification were collected with standard AEP gear, namely Neill cylinders, and are reported in Tables 5 and 6. A list of taxa identified in the samples and the methods used by Dr. Dratnal in sorting and identification, are appended.

These data are also available in electronic spreadsheets.

Table 1. List of sampling sites during the Cardinal Divide survey, 1995-96.

SITE NAME	STATION CODE	LATITUDE	LONGITUDE
McLeod River u/s Cadomin	AB07AF0050	53°00'37"	117°19'55"
Prospect Creek at Mouth	AB07AF0040	52°58'02"	117°19'20"
McLeod River d/s Cheviot	AB07AF0030	52°56'22"	117°17'11"
Cheviot Creek at Mouth	AB07AF0020	52°56'16"	117°17'01"
McLeod River u/s Mountain Park	AB07AF0010	52°53'57"	117°16'38"
Cardinal River near Divide	AB05DD0010	52°53'23"	117°12'58"
Cardinal River u/s Nomad Creek	AB05DD0020	52°52'35"	117°01'34"
Mackenzie Creek u/s Meadow Creek	AB07AF0130	52°56'58"	117°10'44"

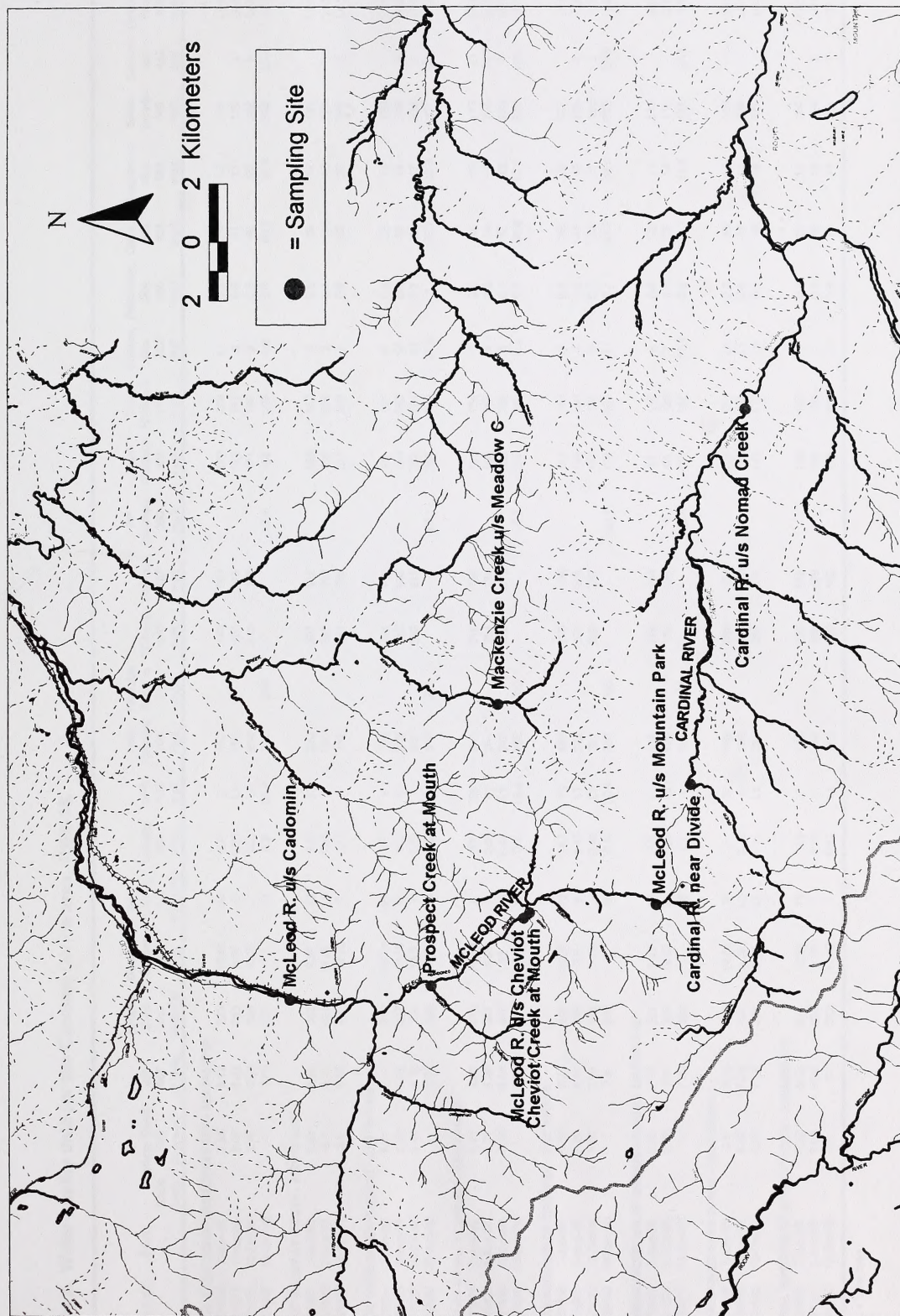


Figure 1. Location of sampling sites during the Cardinal Divide baseline survey, 1995-96.

Table 2. Water quality data for the Cardinal Divide area, 1995-96.

SAMPLE NO.	DATE	Water Temp Code: 840 Units: Degree C	pH 687 pH Units	Specific Cond. 817 USIE/CM	Dissolved Oxygen 659 mg/L	True Colour 443 Rel Units	Turbidity NTU	NFR mg/L	Total Residue mg/L	Filterable Residue mg/L	TDS-diff. mg/L	TDS-calc. mg/L	Alkalinity mg/L	Total Hardness mg/L	Sodium, diss. mg/L	Potassium, diss. mg/L	Calcium, diss. mg/L	Magnesium, diss. mg/L	Bicar- bonate mg/L	Carbon- ate mg/L	Chloride, diss. mg/L
MCLEOD RIVER U/S OF MOUNTAIN PARK - AB07AF0010																					
95AB001816	7-Jun-95	2.65	8.12	228	10.82	23	2.2	3	152	149	124		120	128	L1	0.6	30	13	146		L0.5
95AB001819	1-Aug-95	6.09	8.24	313	9.97	2	0.21	L1	190	190	176		152	173	2	0.4	41	17	179	3	L0.5
95AB001820	12-Oct-95	2.05	7.64	335	10.27	2	0.2	L1	218		195		171	197	3	0.5	46	20	202	3	L0.5
95AB000547	23-Jan-96	7.79		357		10	0.3	L0.4	230	230			168	189	4.8	0.5	45.1	18.5	205	L0.5	
CHEVIOT CREEK AT MOUTH - AB07AF0020																					
95AB001821	7-Jun-95	6.31	8.16	312	9.96	25	7.8	13	220	207	175		139	167	3	0.8	43	14	169		L0.5
95AB001822	2-Aug-95	6.7	8.17	401	9.76	11	1.52	2	260	258	232		185	209	5	0.8	54	18	225		L0.5
95AB001823	11-Oct-95	3.6	8.06	430	10.76	7	0.41	1	282	281	259		211	245	7	0.8	62	22	246	5	L0.5
MCLEOD RIVER D/S OF CHEVIOT - AB07AF0030																					
95AB001824	7-Jun-95	5.41	8.11	202	10.11	56	7.5	8	152	144	108		98	101	5	0.6	25	10	120		L0.5
95AB001825	2-Aug-95	5.33	8.27	327	10.59	9	6.8	5	218	213	188		169	153	14	0.6	38	14	196	5	L0.5
95AB001826	12-Oct-95	2.49	8.15	361	11.1	7	1.25	1	234	233	215		193	174	20	0.7	42	17	223	6	L0.5
95AB000548	23-Jan-96	7.79		495		10	0.8	10	300	290			252	209	37.3	1	51.7	19.3	307	L0.5	L0.5
PROSPECT CREEK AT MOUTH - AB07AF0040																					
95AB001827	7-Jun-95	6.11	8.25	316	10.14	8	27	36	254	218	180		143	174	3	0.5	45	15	173	L1	L0.5
95AB001828	2-Aug-95	8.51	8.29	391	9.68	7	0.65	L1	254	254	231		166	207	4	0.6	54	17	191	6	L0.5
95AB001829	12-Oct-95	-0.09	8.04	447	12	L1	0.43	L1	312	312	271		203	238	6	0.7	57	23	233	7	L0.5
95AB000549	23-Jan-96	7.99		494		5	0.3	L0.4	325	320			215	265	9.4	0.7	68.9	22.6	262	L0.5	L0.5
MCLEOD RIVER U/S OF CADOMIN - AB07AF0050																					
95AB001830	7-Jun-95	6.79	8.24	249	10.26	13	14.7	15	190	175	139		112	136	2	0.5	35	12	137		L0.5
95AB001831	2-Aug-95	8.29	8.24	358	9.9	8	0.41	L1	222	222	205		144	183	4	0.5	47	16	168	4	0.5
95AB001832	12-Oct-95	0.81	7.96	408	11.53	L1	0.48	L1	264	263	257		157	231	5	0.7	57	21	185	3	1.5
95AB000550	24-Jan-96	7.9		500		5	0.5	L0.4	330	325			174	266	8.7	0.7	67.9	23.4	212	L0.5	1.9
MACKENZIE CREEK U/S OF MEADOW CREEK - AB07AF0130																					
95AB001833	2-Aug-95	6.99	7.78	251	9.43	36	3.9	L1	176	176	144		91	115	6	0.6	28	11	111		L0.5
95AB001834	11-Oct-95	2.12	7.6	269	10.67	21	1.8	L1	184	183	162		95	139	7	0.5	32	14	116		0.7
95AB000551	23-Jan-96	7.43		359		10	1.1	1	235	215			116	157	11.4	0.5	38.7	14.7	141	L0.5	1.6
CARDINAL RIVER NEAR DIVIDE - AB05DD0010																					
95AB001563	7-Jun-95	4.3	8.06	242	10.61	3	3	5	166	161	134		107	131	L1	0.3	36	10	130		L0.5
95AB001564	1-Aug-95	6.52	7.74	300	9.39	L1	0.18	6	190	184	170		138	167	L1	0.4	45	13	168		L0.5
95AB001565	12-Oct-95	4.84	7.53	304	9.58	L1	0.13	L1	202	202	174		145	172	L1	0.4	46	14	177		L0.5
CARDINAL RIVER U/S OF NOMAD CREEK - AB05DD0020																					
95AB001566	7-Jun-95	8.15		251	10.66	13	13.3	21	186	166	138		123	138	1	0.4	37	11	150		L0.5
95AB001567	1-Aug-95	7.08	8.22	335	9.96	2	0.18	L1	188	188	179		162	176	1	0.4	48	13	189	4	L0.5
95AB001568	12-Oct-95	2.1	8	312	11.19	2	0.51	L1	200	200	182		168	181	2	0.4	49	14	191	7	L0.5

Note: L = Less than

Table 2. Continued.

SAMPLE NO.	DATE	Sulphate, mg/L	Fluoride, mg/L	Reactive Silica, mg/L	Cyanide, mg/L	Sulphide, mg/L	Nitrogen, mg/L	Nitrite, mg/L	Nitrogen, mg/L	Nitrogen, mg/L	Ammonia, mg/L	Total Ammonia, mg/L	Nitrogen, mg/L	Total Phosphorus, mg/L	Aluminum, mg/L	Arsenic, mg/L	Barium, mg/L	Beryllium, mg/L	Beryllium, mg/L	Cadmium, mg/L	Chromium, mg/L	Cobalt, mg/L
MCLEOD RIVER UIS OF MOUNTAIN PARK - AB07AF0010																						
95AB001818	7-Jun-95	3	0.04	3.8	L0.001	L0.001	L0.001	L0.001	L0.001	0.081	0.002	0.002	0.04	0.005	0.02	0.0002	0.081	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001819	1-Aug-95	23	0.07	4	L0.001	L0.001	L0.001	L0.001	L0.001	0.111	0.004	0.004	0.04	0.002	0.005	L0.0001	0.117	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001820	12-Oct-95	23	0.06	4.4	L0.001	L0.001	L0.001	L0.001	L0.001	0.021	0.003	0.003	0.04	0.002	0.005	L0.0001	0.115	L0.001	L0.001	L0.001	L0.001	L0.001
95AB000547	23-Jan-96	23.5	0.11	5.2	0.001	L0.005	L0.003	L0.003	L0.003	0.078		L0.01	0.11	L0.003	L0.01	L0.0002	0.13	L0.001	L0.0002	L0.002	0.011	0.0005
CHEVOT CREEK AT MOUTH - AB07AF0020																						
95AB001821	7-Jun-95	29	0.1	5.1	L0.001	L0.001	L0.001	L0.001	L0.001	0.021	0.004	0.004	0.05	0.005	0.079	0.0002	0.101	L0.001	L0.001	L0.001	0.001	L0.001
95AB001822	2-Aug-95	43	0.12	5.1	L0.001	L0.001	L0.001	L0.001	L0.001	0.01	0.004	0.004	0.02	0.002	0.015	0.0002	0.13	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001823	11-Oct-95	41	0.13	5	L0.001	L0.001	L0.001	L0.001	L0.001	0.006	0.006	0.006	0.04	0.002	L0.005	0.0001	0.141	L0.001	L0.001	L0.001	L0.001	L0.001
MCLEOD RIVER D/S OF CHEVOT - AB07AF0030																						
95AB001824	7-Jun-95	9	0.08	5	L0.001	0.003	0.001	0.027	0.009	0.027	0.009	0.009	0.28	0.008	0.076	0.0003	0.113	L0.001	L0.001	L0.001	0.001	L0.001
95AB001825	2-Aug-95	20	0.12	5.6	L0.001	L0.001	L0.001	0.014	0.007	0.014	0.007	0.007	0.12	0.002	0.063	0.0002	0.216	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001826	12-Oct-95	19	0.13	5.5	L0.001	L0.001	L0.001	0.023	0.007	0.023	0.007	0.007	0.09	0.002	L0.005	0.0001	0.247	L0.001	L0.001	L0.001	L0.001	L0.001
95AB000548	23-Jan-96	22.6	0.17	6.05	0.001	L0.01	L0.003	0.098				0.01	0.15	L0.003	0.04	L0.0002	0.35	0.001	L0.0002	L0.0002	0.014	0.0004
PROSPECT CREEK AT MOUTH - AB07AF0040																						
95AB001827	7-Jun-95	31	0.08	3.8	L0.001	L0.001	L0.001	0.127	0.004	0.127	0.004	0.004	0.1	0.004	0.177	0.0004	0.097	L0.001	L0.001	L0.001	0.002	0.001
95AB001828	2-Aug-95	55	0.1	4	L0.001	L0.001	L0.001	0.003	0.003	0.003	0.003	0.003	0.03	L0.001	L0.005	L0.0001	0.111	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001829	12-Oct-95	62	0.11	4.5	L0.001	L0.001	L0.001	0.045	L0.001	0.045	L0.001		0.06	0.001	L0.005	L0.0001	0.131	L0.001	L0.001	L0.001	L0.001	L0.001
95AB000549	23-Jan-96	61.3	0.15	5.05	0.001	L0.005	L0.003	0.074				L0.01	0.1	L0.003	0.02	L0.0002	0.15	L0.001	L0.0002	L0.002	0.014	0.0006
MCLEOD RIVER UIS OF CADOMIN - AB07AF0050																						
95AB001830	7-Jun-95	22	0.08	3.8	L0.001	0.002	0.001	0.082	0.003	0.082	0.003	0.003	0.12	0.004	0.09	0.0002	0.066	L0.001	L0.001	L0.001	0.001	L0.001
95AB001831	2-Aug-95	51	0.12	4.1	L0.001	L0.001	L0.001	0.031	0.002	0.031	0.002	0.002	0.03	L0.001	L0.005	L0.0001	0.086	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001832	12-Oct-95	76	0.14	4.6	L0.001	0.001	0.002	0.081	L0.001	0.081	L0.001		0.04	0.001	L0.005	0.0001	0.091	L0.001	L0.001	L0.001	L0.001	L0.001
95AB000550	24-Jan-96	91.1	0.2	5.15	L0.001	L0.005	L0.003	0.104				L0.01	0.09	L0.003	L0.01		0.11	L0.001	L0.0002	L0.002	0.01	0.0006
MACKENZIE CREEK UIS OF MEADOW CREEK - AB07AF0130																						
95AB001833	2-Aug-95	43	0.15	6.4	L0.001	L0.001	L0.001	0.001	0.002	0.002	0.008	0.008	0.18	0.006	L0.005	0.0001	0.079	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001834	11-Oct-95	50	0.17	6.3	L0.001	L0.001	L0.001	0.001	0.002	0.002	0.006		0.1	0.007	0.015	0.0002	0.068	L0.001	L0.001	L0.001	0.001	L0.001
95AB000551	23-Jan-96	66.3	0.2	5.97	0.001	L0.005	L0.003	0.008				L0.01	0.14	0.006	0.01	L0.0002	0.08	0.001	L0.0002	L0.0002	0.009	0.0005
CARDINAL RIVER NEAR DIVIDE - AB05DD0010																						
95AB001563	7-Jun-95	21	0.06	2.6	L0.001	L0.001	L0.001	0.149	0.002	0.149	0.002	0.002	0.02	0.002	L0.005	0.0001	0.025	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001564	1-Aug-95	28	0.07	3.6	L0.001	L0.001	L0.001	0.085	L0.001	0.085	L0.001		0.04	0.002	L0.005	L0.0001	0.048	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001565	12-Oct-95	25	0.06	3.5	L0.001	L0.001	L0.001	0.118					0.03	L0.001	L0.005	L0.0001	0.054	L0.001	L0.001	L0.001	L0.001	L0.001
CARDINAL RIVER UIS OF NOMAD CREEK - AB05DD0020																						
95AB001566	7-Jun-95	13	0.05	4.1	L0.001	L0.001	L0.001	0.108	0.003	0.108	0.003	0.003	0.08	0.002	0.079	0.0002	0.05	L0.001	L0.001	L0.001	0.001	L0.001
95AB001567	1-Aug-95	17	0.07	5.4	L0.001	L0.001	L0.001	0.055	0.004	0.055	0.004	0.004	0.06	L0.001	L0.005	L0.0001	0.073	L0.001	L0.001	L0.001	L0.001	L0.001
95AB001568	12-Oct-95	15	0.06	5.1	L0.001	L0.001	L0.001	0.078	L0.001	0.078	L0.001		0.02	L0.001	L0.005	L0.0001	0.071	L0.001	L0.001	L0.001	L0.001	L0.001

Table 2. Continued.

SAMPLE NO.	DATE	Copper, mg/L	Lead, extr. mg/L	Iron, tot. mg/L	Lead, tot. mg/L	Manganese, tot. mg/L	Mercury, tot. ug/L	Molybdenum, tot. mg/L	Nickel, tot. mg/L	Selenium, tot. mg/L	Vanadium, tot. mg/L	Zinc, tot. mg/L	Carbon Dissolved Organic mg/L	Carbon Part. Org. mg/L	Carbon, Tot. mg/L	BOD mg/L	COD mg/L	Phenols mg/L	Tannin and Lignin mg/L	Fecal Coliforms No./DL	Total Coliforms 434 No./DL
MCLEOD RIVER UIS OF MOUNTAIN PARK - AB07AF0010																					
95AB001818	7-Jun-95	L0.001	L0.002	0.088	L0.002	L0.001	L0.04	L0.001	L0.001	0.0002	L0.002	0.002	3.6	0.28	0.28	4	4	0.003	0.46	600	1900
95AB001819	1-Aug-95	L0.001	L0.002	0.016	L0.002	L0.001	L0.04	L0.001	L0.001	L0.0001	L0.002	L0.001	1.4	0.26	0.26	L4	L4	0.001	0.24	L4	L4
95AB001820	12-Oct-95	L0.001	0.005	0.004	L0.003	L0.001	L0.05	L0.003	0.0091	L0.0002	L0.002	L0.001	1.4	0.33	0.33	L4	L4	L0.001	0.6	4	190
96AB000547	23-Jan-96	L0.001	L0.003	L0.001	L0.003	L0.001	L0.05	L0.003	0.0091	L0.0002	L0.002	L0.001	1.8	L0.2	0.2	5	5	L0.001	L0.1		
CHEVIOT CREEK AT MOUTH - AB07AF0020																					
95AB001821	7-Jun-95	0.002	L0.002	0.415	L0.002	0.008	L0.04	L0.001	L0.001	0.0003	L0.002	0.004	4.7	0.98	0.98	13	13	0.003	0.75	L4	L4
95AB001822	2-Aug-95	L0.001	L0.002	0.086	L0.002	0.008	L0.04	L0.001	L0.001	0.0002	L0.002	0.002	1.1	0.41	0.41	9	9	0.002	0.59	L4	L4
95AB001823	11-Oct-95	L0.001	L0.002	0.025	L0.002	0.003	L0.04	L0.001	L0.001	0.0002	L0.002	L0.001	2.3	0.29	0.29	L4	L4	L0.001	2.8	L4	12
MCLEOD RIVER DIS OF CHEVIOT - AB07AF0030																					
95AB001824	7-Jun-95	0.002	L0.002	0.38	L0.002	0.009	L0.04	L0.001	0.002	0.0005	L0.002	0.004	7.4	0.59	0.59	15	15	0.004	1.06	4	12
95AB001825	2-Aug-95	L0.001	L0.002	0.345	L0.002	0.01	L0.04	L0.001	0.001	0.0001	0.003	0.002	3	0.95	0.95	20	20	0.002	0.44	L4	L4
95AB001826	12-Oct-95	L0.001	0.043	0.008	L0.003	0.006	L0.04	L0.001	0.001	0.0002	L0.002	L0.001	2.2	0.38	0.38	L4	L4	L0.001	0.17	L4	72
96AB000548	23-Jan-96	0.002	L0.003	L0.001	L0.003	0.001	L0.05	0.003	0.0058	L0.0002	L0.002	L0.001	1.9	L0.2	0.2	L5	L5	L0.001	L0.1		
PROSPECT CREEK AT MOUTH - AB07AF0040																					
95AB001827	7-Jun-95	0.001	L0.002	0.36	L0.002	0.014	L0.04	L0.001	0.003	0.0005	0.003	0.005	1.7	0.98	0.98	L4	L4	L0.001	0.88	L4	L4
95AB001828	2-Aug-95	L0.001	L0.002	0.039	L0.002	0.002	L0.04	L0.001	L0.001	L0.0001	L0.002	0.001	1.2	0.35	0.35	20	20	L0.001	0.43	4	4
95AB001829	12-Oct-95	0.002	0.015	0.002	L0.003	0.003	L0.04	L0.001	0.004	0.0001	L0.002	L0.001	1	0.3	0.3	L4	L4	L0.001	1.58	L4	18
96AB000549	23-Jan-96	L0.001	L0.003	L0.001	L0.003	L0.001	L0.05	0.003	0.011	L0.0002	L0.002	L0.001	1.2	L0.2	0.2	7	7	L0.001	L0.1		
MCLEOD RIVER UIS OF CADOMIN - AB07AF0050																					
95AB001830	7-Jun-95	L0.001	L0.002	0.441	L0.002	0.008	L0.04	L0.001	0.001	0.0005	0.002	0.004	2.3	0.8	0.8	L4	L4	0.002	0.53	4	8
95AB001831	2-Aug-95	0.002	L0.002	0.021	L0.002	L0.001	L0.04	L0.001	L0.001	L0.0001	0.003	0.002	1.7	0.22	0.22	27	27	L0.001	0.3	4	4
95AB001832	12-Oct-95	L0.001	L0.002	0.01	L0.003	L0.001	L0.04	0.001	0.004	L0.0001	L0.002	L0.001	1	0.25	0.25	L4	L4	L0.001	1.1	L4	4
96AB000550	24-Jan-96	L0.001	L0.003	L0.001	L0.003	L0.001	L0.05	0.003	0.011	L0.0002	0.003	0.002	3.5	L0.2	0.2	5	5	L0.001	L0.1		
MACKENZIE CREEK UIS OF MEADOW CREEK - AB07AF0130																					
95AB001833	2-Aug-95	0.002	L0.002	0.193	L0.002	L0.001	L0.04	L0.001	0.003	L0.0001	0.002	0.002	5.3	0.35	0.35	32	32	0.002	0.61	L4	L4
95AB001834	11-Oct-95	L0.001	L0.002	0.07	L0.002	L0.001	L0.04	L0.001	0.001	0.0001	L0.002	L0.001	4	0.26	0.26	L4	L4	L0.001	0.34	L4	L4
96AB000551	23-Jan-96	L0.001	L0.003	L0.001	L0.003	L0.001	L0.05	L0.003	0.0082	L0.0002	L0.002	0.005	3.5	L0.2	0.2	12	12	L0.001	L0.1		
CARDINAL RIVER NEAR DIVIDE - AB05DD0010																					
95AB001563	7-Jun-95	L0.001	L0.002	0.09	L0.002	0.001	L0.04	L0.001	L0.001	0.0002	L0.002	0.002	0.8	0.45	0.45	L4	L4	L0.001	0.2	15	39
95AB001564	1-Aug-95	L0.001	L0.002	0.011	L0.002	L0.001	L0.04	0.002	L0.001	L0.0001	L0.002	L0.001	0.6	0.24	0.24	L4	L4	L0.001	0.17	L4	18
95AB001565	12-Oct-95	L0.001	L0.002	0.003	L0.002	L0.001	L0.04	L0.001	L0.001	0.0001	L0.002	L0.001	0.7	0.36	0.36	L4	L4	L0.001	0.82	L4	L4
CARDINAL RIVER UIS OF NOMAD CREEK - AB05DD0020																					
95AB001566	7-Jun-95	L0.001	L0.002	0.363	L0.002	0.006	L0.04	L0.001	L0.001	0.0003	L0.002	0.003	1.9	1.44	1.44	L4	L4	0.001	0.48	L4	8
95AB001567	1-Aug-95	0.001	L0.002	0.017	L0.002	L0.001	L0.04	L0.001	0.004	L0.0001	L0.002	0.002	2.1	0.22	0.22	L4	L4	L0.001	0.21	4	9
95AB001568	12-Oct-95	L0.001	0.005	L0.001	L0.003	L0.001	L0.04	L0.001	L0.001	L0.0001	L0.002	L0.001	0.9	0.23	0.23	L4	L4	L0.001	0.51	L4	12

Table 3. Trace organic 'extractable priority pollutants' and AOX - Cardinal Divide area, 1995-96.

COMPOUND	STATION NO.:		AB07AF0050		AB07AF0130		AB05DD0020	
	STATION NAME:		MCLEOD RIVER U/S OF CADOMIN		MACKENZIE CREEK U/S OF MEADOW CREEK		CARDINAL RIVER U/S OF NOMAD CREEK	
	SAMPLE NO.:	SAMPLE DATE:	95AB004516	95AB004517	96AB001603	96AB001604	95AB004518	95AB004486
			02-Aug-95	12-Oct-95	24-Jan-96	24-Jan-96	02-Aug-95	01-Aug-95
	Variable Code	Unit Code	0.003	0.004	L0.025		0.008	0.003
ADSORBABLE ORGANIC HALIDES (AOX)	944	mg/L						
DISSOLVED AOX	9014	mg/L		L1	L1		L1	L1
1,2,4-TRICHLOROBENZENE	95	ug/L		L1	L1		L1	L1
1,2-DIPHENYLHYDRAZINE	102	ug/L		L1	L1		L1	L1
2,4,6-TRICHLOROPHENOL	308	ug/L		L1	L1		L1	L1
2,4-DICHLOROPHENOL	96	ug/L		L2	L2		L2	L2
2,4-DIMETHYLPHENOL	62	ug/L		L1	L1		L1	L1
2,4-DINITROPHENOL	205	ug/L		L1	L1		L1	L1
2,4-DINITROTOLUENE	97	ug/L		L1	L1		L1	L1
2,6-DINITROTOLUENE	236	ug/L		L1	L1		L1	L1
2-CHLORONAPHTHALENE	315	ug/L		L1	L1		L1	L1
2-CHLOROPHENOL	330	ug/L		L2	L2		L2	L2
2-METHYL-4,6-DINITROPHENOL	213	ug/L		L1	L1		L1	L1
2-NITROPHENOL	309	ug/L		L1	L1		L1	L1
4-BROMOPHENYL PHENYL ETHER	59	ug/L		L1	L1		L1	L1
4-CHLORO-3-METHYLPHENOL	231	ug/L		L1	L1		L1	L1
4-CHLOROPHENYL PHENYL ETHER	253	ug/L		L1	L1		L1	L1
4-NITROPHENOL	51	ug/L		L1	L1		L1	L1
ACENAPHTHENE	292	ug/L		L1	L1		L1	L1
ACENAPHTHYLENE	148	ug/L		L1	L1		L1	L1
ANTHRACENE	93	ug/L		L1	L1		L1	L1
BENZ(A)ANTHRACENE	219	ug/L		L1	L1		L1	L1
BENZIDINE	316	ug/L		L2	L2		L2	L2
BENZO(A)PYRENE	204	ug/L		L1	L1		L1	L1
BENZO(B)FLUORANTHENE	145	ug/L		L1	L1		L1	L1
BENZO(G,H,I)PERYLENE	132	ug/L		L2	L2		L2	L2
BENZO(K)FLUORANTHENE	147	ug/L		L1	L1		L1	L1
BENZOIC ACID	249	ug/L		L2	L2		L2	L2
BIS(2-CHLOROETHOXY) ETHER	79	ug/L		L1	L1		L1	L1
BIS(2-CHLOROETHYL) ETHER	78	ug/L		L1	L1		L1	L1
BIS(2-CHLOROISOPROPYL) ETHER	71	ug/L		L1	L1		L1	L1
BUTYLBENZYL PHTHALATE	300	ug/L		L1	L1		L1	L1
CHRYSENE	155	ug/L		L1	L1		L1	L1
DI-N-BUTYL PHTHALATE	297	ug/L		L1	L1		L1	L1
DI-N-OCTYL PHTHALATE	90	ug/L		L1	L1		L1	L1
DIBENZ(A,H)ANTHRACENE	212	ug/L		L5	L5		L5	L5
DIETHYL PHTHALATE	295	ug/L		L5	L5		L5	L5
DIMETHYL PHTHALATE	108	ug/L		L1	L1		L1	L1
FLUORANTHENE	146	ug/L		L1	L1		L1	L1
FLUORENE	303	ug/L		L1	L1		L1	L1
HEXACHLOROBENZENE	91	ug/L		L1	L1		L1	L1
HEXACHLOROBUTADIENE	306	ug/L		L5	L5		L5	L5
HEXACHLOROCYCLOPENTADIENE	282	ug/L		L1	L1		L1	L1
HEXACHLOROETHANE	251	ug/L		L1	L1		L1	L1
HEXADECANOIC ACID	222	ug/L		L5	L5		L5	L5
INDENO(1,2,3-C,D)PYRENE	140	ug/L		L3	L3		L3	L3
ISOPHORONE	284	ug/L		L1	L1		L1	L1
N-nitrosodi-n-propylamine	242	ug/L		L2	L2		L2	L2
N-NITROSODIPHENYLAMINE	301	ug/L		L1	L1		L1	L1
NAPHTHALENE	312	ug/L		L1	L1		L1	L1
NITROBENZENE	339	ug/L		L1	L1		L1	L1
PENTACHLOROPHENOL	307	ug/L		L1	L1		L1	L1
PERYLENE	141	ug/L		L1	L1		L1	L1
PHENANTHRENE	299	ug/L		L1	L1		L1	L1
PHENOL	75	ug/L		L1	L1		L1	L1
PYRENE	107	ug/L		L1	L1		L1	L1

Note: L = less than

Table 4. Epilithic chlorophyll a data from the Cardinal Divide area, 1995.

STATION CODE	SITE NAME	DATE	REPLICATE SAMPLE:					
			1	2	3	4	5	6
AB07AF0010	MCLEOD RIVER U/S OF MOUNTAIN PARK	1-Aug-95	24.4	6.3	26.6			
		12-Oct-95	3.3	3.6	4.1			
AB07AF0030	MCLEOD RIVER D/S OF CHEVIOT	2-Aug-95	97.2	97.4	272	306	101	106
		12-Oct-95	268	140	160			
AB07AF0050	MCLEOD RIVER U/S OF CADOMIN	2-Aug-95	32.5	29.9	44.7	7.9	135	8.3
		12-Oct-95	47.2	73	37.8			
AB07AF0130	MACKENZIE CREEK U/S OF MEADOW CREEK	2-Aug-95	16.2	6.7	4.9			
		11-Oct-95	2.3	7.1	3.9			
AB05DD0010	CARDINAL RIVER NEAR DIVIDE	1-Aug-95	14.8	10.1	14.3			
		12-Oct-95	3.6	2	6.4			
AB05DD0020	CARDINAL RIVER U/S OF NOMAD CREEK	1-Aug-95	3.3	2.8	1.7			
		12-Oct-95	2.1	1.4	1.4			

Note: Values as mg/m²

Table 5. Number of benthic invertebrates per replicate sample collected from the Cardinal Divide area in August, 1995.

Site: McLeod River u/s Mt. Park		AB07AF0010			
Sample date & time:	1-Aug-95	14:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	12	27	38	53	33
NEMATODA		39	26	3	23
OLIGOCHAETA					
Enchytraeidae		3	28		6
ACARI					
Stygothrombidiidae	3	48	12	14	30
other	26	93	121	74	78
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	6	30	109	18	
COLLEMBOLA					
Isotomidae				2	2
EPHEMEROPTERA					
Baetidae					
<i>Acentrella</i> sp.					
<i>Baetis</i> sp.	20	48	29	48	44
Ephemerellidae					
<i>Drunella doddsi</i>			9		4
Heptageniidae					
<i>Cinygmula</i> sp.	3	5	6	7	4
<i>Epeorus</i> sp.	7	15	22	17	17
<i>Rhithrogena</i> sp.	10	25	15	6	6
early nymphs	33	95	127	68	52
Siphonuridae					
<i>Ameletus</i> sp.		1			
PLECOPTERA					
Capniidae					
early nymphs	16	79	54	43	41
Chloroperlidae					
early nymphs	27	170	192	129	65
Leuctridae	11	11	84	51	26
Nemouridae					
<i>Zapada</i> sp.	19	7	9	9	9
Perlodidae					
<i>Megarcys</i> sp.	2	1	3	1	2
TRICHOPTERA					
Rhyacophilidae					
<i>Rhyacophila</i> spp.		2	1		1
DIPTERA					
Chironomidae					
Diamesinae	2	3	18	7	4
Orthocladiinae	97	216	291	137	141
Chironomini	1				
Tanytarsini				4	5
Empididae					
<i>Chelifera</i> sp.		1	1		
<i>Oreogeton</i> sp.		8	4		2
Simuliidae	5	4	3	3	12
Tipulidae					
<i>Gonomyodes</i> sp.		3			2
Total taxa	18	24	23	20	24
Total individuals	300	934	1202	694	609

Site: McLeod River d/s Cheviot		AB07AF0030			
Sample date & time:	2-Aug-95	9:30			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA		Replicate sample			
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	109	60	12	83	75
NEMATODA	4				4
NEMATOMORPHA					
Chordodidae				1	1
OLIGOCHAETA					
Enchytraeidae	4				
ACARI					
Stygothrombidiidae	8				
other	120	94	57	90	56
COPEPODA					
Cyclopoida					4
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	1056	40	12	748	204
COLLEMBOLA					
Isotomidae				4	1
EPHEMEROPTERA					
Baetidae					
<i>Acentrella</i> sp.	1				
<i>Baetis</i> sp.	127	136	120	464	233
Ephemerellidae					
<i>Drunella doddsi</i>	36	48	16	98	19
<i>Drunella</i> sp.	30	34	6	30	2
<i>Ephemerella</i> sp.					
Heptageniidae					
<i>Cinygmula</i> sp.	9	95	11	8	5
<i>Epeorus</i> sp.	16	72	4	11	4
early nymphs	276	780	156	209	100
Siphonuridae					
<i>Ameletus</i> sp.	9	19	4		13
PLECOPTERA					
Capniidae					
early nymphs	21	64	27	71	45
Chloroperlidae					
<i>Sweltsa</i> sp.	1	1			
early nymphs	144	130	65	169	89
Leuctridae	44	3	17	38	18
Nemouridae					
<i>Zapada</i> sp.				4	
Perlodidae					
<i>Kogotus</i> sp.		1			
early nymphs	4				1
TRICHOPTERA					
Hydropsychidae					
<i>Parapsyche</i> sp.				5	
Rhyacophilidae					
<i>Rhyacophila</i> spp.	16	9	5	29	16
COLEOPTERA					
Elmidae					
<i>Heterlimnius</i> sp.	20	9	24	22	10
DIPTERA					
Ceratopogonidae			4		
Chironomidae					
Tanypodinae				8	
Diamesinae	43	12	7	107	103
Orthocladiinae	903	875	616	1540	768
Tanytarsini	6	52	4	9	9
Empididae					
<i>Chelifera</i> sp.	56	7	6	44	13
Simuliidae				5	5
Tipulidae					
<i>Limnophila</i> sp.				4	
Total taxa	25	21	20	25	25
Total individuals	3063	2541	1173	3801	1798

Site: McLeod River u/s Cadomin		AB07AF0050			
Sample date & time:	2-Aug-95	13:15			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	6	10	60	6	12
NEMATODA	1				5
OLIGOCHAETA					
Lumbriculidae	9	12	7	2	4
ACARI					
Stygothrombidiidae		12	4		4
other	36	115	83	133	129
COPEPODA					
Harpacticoida				4	
OSTRACODA					
Candonidae					
<i>Candona</i> sp.				8	
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	20	26	4	52	21
Ephemerellidae					
<i>Drunella doddsi</i>	13	17	11	64	3
<i>Drunella</i> sp.		2	1	1	1
Heptageniidae					
<i>Cinygmula</i> sp.	8	8	12	8	19
<i>Epeorus</i> sp.	7	31	15	9	18
<i>Rhithrogena</i> sp.		3	6	2	3
early nymphs	44	120	124	120	92
Siphonuridae					
<i>Ameletus</i> sp.		12		4	8
PLECOPTERA					
Capniidae					
early nymphs	28	43	83	68	77
Chloroperlidae					
<i>Neaviperla</i> sp.	9	7	4	2	8
early nymphs	6	8	33	14	17
Nemouridae					
<i>Zapada</i> sp.		8	5	2	9
Perlodidae					
<i>Kogotus</i> sp.		2			
early nymphs	14	16	15	28	13
TRICHOPTERA					
Hydropsychidae					
<i>Parapsyche</i> sp.		5	1	1	
Rhyacophilidae					
<i>Rhyacophila</i> spp.	1	1			1
DIPTERA					
Chironomidae					
Diamesinae	19	8	29	17	18
Orthocladiinae	895	852	728	820	961
Tanytarsini	27	37	54	32	57
Empididae					
<i>Chelifera</i> sp.	4	1	5	16	13
<i>Clinocera</i> sp.	1	5		4	8
Simuliidae			8	8	8
Total taxa	19	25	22	25	25
Total individuals	1148	1361	1292	1425	1509

Site: MacKenzie Creek d/s Lease	AB07AF0130				
Sample date & time:	2-Aug-95	11:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>		1	1	1	
NEMATODA	6	6	4	3	14
OLIGOCHAETA					
Enchytraeidae				1	
ACARI					
Stygotrombidiidae	11	3	22	1	11
other	27	19	18	17	23
CLADOCERA	3		1	1	
COPEPODA					
Cyclopoida	3	2	2		4
Harpacticoida			1		
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	3	5	2	1	
COLLEMBOLA					
Isotomidae				1	
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	1	1			
Ephemerellidae					
<i>Drunella</i> sp.					1
early nymphs	8			2	
Heptageniidae					
<i>Cinygmula</i> sp.	6	8	3	2	4
<i>Epeorus</i> sp.	6	4	1	3	1
early nymphs	121	15	20	19	60
Siphonuridae					
<i>Ameletus</i> sp.	6	5	14	2	11
PLECOPTERA					
Capniidae					
early nymphs	8	12	5	11	11
Chloroperlidae					
<i>Neaviperla</i> sp.			1		
early nymphs	15	7	9	8	3
Nemouridae					
<i>Zapada</i> sp.		3			
Perlodidae					
early nymphs	3	2			1
TRICHOPTERA					
Limnephilidae					
early larvae		1			
Rhyacophilidae					
<i>Rhyacophila</i> spp.	1	1	1		1
DIPTERA					
Chironomidae					
Diamesinae	30	15	29	13	39
Orthocladiinae	60	110	71	42	109
Tanytarsini		1			
Empididae					
<i>Chelifera</i> sp.		1			
<i>Clinocera</i> sp.	1				
Total taxa	19	21	18	17	15
Total individuals	319	222	205	128	293

Site: Cardinal River near Divide		AB05DD0010			
Sample date & time:	1-Aug-95	13:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	1	4	2	7	1
NEMATODA	1			1	
OLIGOCHAETA					
Lumbriculidae	13	16		1	
ACARI	2				
COPEPODA					
Harpacticoida	1				
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	6	3	3	6	6
Ephemerellidae					
<i>Drunella</i> sp.			1		
early nymphs				1	
Heptageniidae					
<i>Cinygmula</i> sp.	25	32	13	45	23
<i>Epeorus</i> sp.	4	7	23	16	13
<i>Rhythrogena</i> sp.	14	4	20	6	7
early nymphs	37	48	58	64	52
Siphonuridae					
<i>Ameletus</i> sp.	19	59	31	37	23
PLECOPTERA					
Capniidae					
early nymphs	13	19	16	21	6
Chloroperlidae					
early nymphs	2		2	5	2
Leuctridae	1		1		
Nemouridae					
<i>Zapada</i> sp.		1	1	1	1
Perlodidae					
early nymphs	2	3	2	1	
Taeniopterygidae					
<i>Taenionema</i> sp.				1	3
TRICHOPTERA					
DIPTERA					
Chironomidae					
Tanypodinae			1		
Diamesinae	10	6	6	2	15
Orthoclaadiinae	31	60	61	52	57
Tanytarsini		1	3	1	1
Empididae					
<i>Chelifera</i> sp.	2		2	1	2
Simuliidae					3
Total taxa	18	14	18	19	16
Total individuals	184	263	246	269	215

Site: Cardinal River d/s (u/s Nomad Ck)			AB05DD0020		
Sample date & time:	31-Jul-95	11:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	16	3	3	8	8
NEMATODA		2		6	
ACARI					
Stygothrombidiidae		2	16	2	4
other	10	12	26	8	
COPEPODA					
Cyclopoida				4	2
OSTRACODA					
Candonidae					
<i>Candona sp.</i>	8	26	28	6	2
EPHEMEROPTERA					
Baetidae					
<i>Baetis sp.</i>	30	33	32	16	25
Ephemerellidae					
<i>Drunella doddsi</i>	19	5	5		4
<i>Drunella sp.</i>	2	1	2		
<i>Ephemerella sp.</i>	3	1			
early nymphs	4		2		
Heptageniidae					
<i>Cinygmula sp.</i>	20	20	5	4	3
<i>Epeorus sp.</i>	12	7	3		1
<i>Rhithrogena sp.</i>	18	20	32	29	14
early nymphs	182	198	150	321	298
Siphonuridae					
<i>Ameletus sp.</i>	8	22	89	81	127
PLECOPTERA					
Capniidae					
early nymphs	93	98	78	123	68
Chloroperlidae					
<i>Sweltsa sp.</i>		1			
early nymphs	58	164	176	212	111
Leuctridae	3	13		12	9
Nemouridae					
<i>Zapada sp.</i>	50	11	5	5	2
Perlidae					
<i>Hesperoperla pacifica</i>	1				
Perlodidae					
<i>Megarcys sp.</i>	1				
early nymphs	8				
Taeniopterygidae					
<i>Taenionema sp.</i>	18	14	8	7	10
TRICHOPTERA					
Hydropsychidae					
<i>Parapsyche sp.</i>			1		
Rhyacophilidae					
<i>Rhyacophila spp.</i>	5		4	4	
DIPTERA					
Chironomidae					
Diamesinae	4				
Orthocladiinae	61	130	66	100	38
Tanytarsini	49	98	57	13	6
Empididae					
<i>Chelifera sp.</i>	7	10	19		
Simuliidae			2		
Tipulidae					
<i>Dicranota sp.</i>	1				
Total taxa	27	23	23	19	18
Total individuals	691	891	809	961	732

Table 6. Number of benthic invertebrates per replicate sample collected from the Cardinal Divide area in October, 1995.

Site: McLeod River u/s Mt. Park			AB07AF0010		
Sample date & time:	12-Oct-95	14:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	3	11	5	28	29
NEMATODA	17	261	29	22	20
OLIGOCHAETA					
Enchytraeidae	18	182	83	84	27
ACARI					
Stygothrombidiidae		8			8
other	102	136	31	180	141
COPEPODA					
Cyclopoida		4		4	
Harpacticoida	4	44	8	4	4
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	4	16		4	12
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	255	307	315	488	36
Ephemerellidae					
<i>Drunella doddsi</i>	6	4	2	6	1
early nymphs	36	120	16	160	92
Heptageniidae					
<i>Cinygmula</i> sp.	94	132	113	178	52
<i>Epeorus</i> sp.	9			13	5
<i>Rhithrogena</i> sp.	4	1	3	5	
early nymphs	340	592	404	1284	704
Siphonuridae					
<i>Ameletus</i> sp.	80	147	40	132	237
PLECOPTERA					
Capniidae					
<i>Isocapnia</i> sp.	1				
early nymphs	35	84	17	107	198
Chloroperlidae					
<i>Alloperla</i> sp.					1
<i>Sweltsa</i> sp.		1			
early nymphs	56	106	12	56	54
Nemouridae					
<i>Zapada</i> sp.	25	4			1
Perlodidae					
<i>Megarcys</i> sp.		3	5	1	
early nymphs	64	55	60	120	17
Taeniopterygidae					
<i>Taenionema</i> sp.	2				
TRICHOPTERA					
Limnephilidae					
early larvae		5	1	3	37
Rhyacophilidae					
<i>Rhyacophila</i> spp.			1	1	3
DIPTERA					
Chironomidae					
Tanypodinae					
Diamesinae	13	28	6	27	46
Orthoclaadiinae	523	666	151	453	486
Tanytarsini	16	60	17	40	16
Empididae					
<i>Chelifera</i> sp.		3	1		1
<i>Clinocera</i> sp.		3		1	1
<i>Oreogeton</i> sp.		2		1	2
Psychodidae					
<i>Pericoma/Telmatoscopus</i>	12	8	1		17
Simuliidae		1			
Tipulidae					
<i>Dicranota</i> sp.		5	4	1	
<i>Gonomyodes</i> sp.	1	4			1
Total taxa	25	32	24	27	29
Total individuals	1720	3003	1325	3403	2249

Site: McLeod River d/s Cheviot	AB07AF0030				
Sample date & time:	12-Oct-95	16:00			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	21	14	24	38	40
NEMATODA	30	24	20	57	72
OLIGOCHAETA					
Enchytraeidae	31	4	20	24	13
ACARI	9	109	112	186	168
COPEPODA					
Harpacticoida			4		
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	20	4	36	44	68
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	156	665	228	574	787
Ephemerellidae					
<i>Drunella doddsi</i>	37	46	13	40	57
early nymphs	30	278	138	238	300
Heptageniidae					
<i>Cinygmula</i> sp.	117	34		1	9
<i>Epeorus</i> sp.		1	1		
<i>Rhithrogena</i> sp.	244	1			
early nymphs	35	118	46	46	42
Siphonuridae					
<i>Ameletus</i> sp.	2	5	12	44	5
PLECOPTERA					
Capniidae					
early nymphs	5	25	33	7	22
Chloroperlidae					
early nymphs	37	14	26	10	16
Leuctridae	2	12	11	7	14
Nemouridae					
<i>Zapada</i> sp.	2	68	45	98	41
Perlodidae					
<i>Megarcys</i> sp.	1				
early nymphs		1	1	1	1
Taeniopterygidae					
<i>Taenionema</i> sp.	1		4		1
TRICHOPTERA					
Glossosomatidae					
<i>Glossosoma</i> sp.		9	8	12	4
Hydropsychidae					
early larvae					1
Limnephilidae					
<i>Ecclisomyia</i> sp.		1			
Rhyacophilidae					
<i>Rhyacophila</i> spp.	1				2
COLEOPTERA					
Elmidae					
<i>Heterlimnius</i> sp.	2	14	7	16	2
DIPTERA					
Chironomidae					
Diamesinae	562	159	94	137	300
Orthocladiinae	78	1037	1044	1920	2042
Tanytarsini	17	32	12	48	52
Empididae					
<i>Chelifera</i> sp.	4	4	1	5	9
<i>Clinocera</i> sp.			1		2
<i>Oreogeton</i> sp.					1
Psychodidae					
<i>Pericoma/Telmatoscopus</i>		4			
Tipulidae					
<i>Dicranota</i> sp.		2	6	2	5
<i>Hesperoconopa</i> sp.					1
Total taxa	24	27	26	23	29
Total individuals	1444	2685	1947	3555	4077

Site: McLeod River u/s Cadomin		AB07AF0050			
Sample date & time:	12-Oct-95	7:45			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	12	3	23	26	81
NEMATODA	13				
OLIGOCHAETA					
Naididae			4		
Lumbriculidae	3		2	11	16
ACARI					
Stygothrombidiidae	8	1	4	24	8
other	80	22	130	80	94
COPEPODA					
Cyclopoida				4	
Harpacticoida		1		4	
OSTRACODA					
Candonidae					
<i>Candona</i> sp.		1			
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	49	11	84	44	115
Ephemerellidae					
<i>Drunella doddsi</i>	6	2	3	4	4
early nymphs	32	2	59	29	99
Heptageniidae					
<i>Cinygmula</i> sp.	1				1
<i>Epeorus</i> sp.	1				
<i>Rhithrogena</i> sp.	4	2	3	1	4
early nymphs	92	51	221	201	418
Siphonuridae					
<i>Ameletus</i> sp.	9	1	8	1	15
PLECOPTERA					
Capniidae					
early nymphs	13	8	149	58	54
Chloroperlidae					
<i>Sweltsa</i> sp.					1
early nymphs	8	19	22	47	86
Leuctridae	12	7	53	40	45
Nemouridae					
<i>Zapada</i> sp.	123	21	143	89	115
Perlodidae					
<i>Megarcys</i> sp.	2	2	2	4	1
early nymphs			11		4
Taeniopterygidae					
<i>Taenionema</i> sp.	41	22	38	16	38
TRICHOPTERA					
Glossosomatidae					
<i>Glossosoma</i> sp.			4		
Hydropsychidae					
<i>Parapsyche</i> sp.	2		1	1	
early larvae		2			
DIPTERA					
Ceratopogonidae				1	
Chironomidae					
Diamesinae	125	18	108	105	59
Orthocladiinae	265	57	932	303	491
Tanytarsini	12	14	96	72	41
Empididae					
<i>Chelifera</i> sp.			1	5	8
<i>Clinocera</i> sp.				4	
<i>Oreogeton</i> sp.				1	
Psychodidae					
<i>Pericoma/Telmatoscopus</i>		1			
Tipulidae					
<i>Dicranota</i> sp.			2	12	1
Total taxa	23	22	25	27	24
Total individuals	913	268	2103	1187	1799

Site: Cardinal River near Divide		AB05DD0010			
Sample date & time:	12-Oct-95	12:15			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	10		6	1	5
NEMATODA			28	4	4
OLIGOCHAETA					
Enchytraeidae					12
Lumbriculidae					7
ACARI					
Stygothrombidiidae	8	4	5		16
other	60	32	108	8	16
COPEPODA					
Cyclopoida	4	4	8		
Harpacticoida					8
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	24	4	120		4
EPHEMEROPTERA					
Baetidae					
<i>Acentrella</i> sp.			1		
<i>Baetis</i> sp.	12	17	365	50	105
Ephemerellidae					
<i>Drunella doddsi</i>			1	1	1
early nymphs	20	4	87	16	20
Heptageniidae					
<i>Cinygmula</i> sp.		3	2	1	
<i>Rhiithrogena</i> sp.	25	7		8	9
early nymphs	1490	1556	957	463	430
Siphonuridae					
<i>Ameletus</i> sp.	62	93	38	4	16
PLECOPTERA					
Capniidae					
early nymphs	128	130	587	20	18
Chloroperlidae					
<i>Sweltsa</i> sp.		2			1
early nymphs	95	81	48	10	67
Leuctridae	9	3	20		1
Nemouridae					
<i>Zapada</i> sp.	400	571	2662	213	148
Perlodidae					
<i>Isoperla</i> sp.		2	3		
<i>Megarcys</i> sp.	11	12	1	8	5
early nymphs			3	5	
Taeniopterygidae					
<i>Taenionema</i> sp.	70	7	102	74	143
TRICHOPTERA					
Glossosomatidae					
<i>Glossosoma</i> sp.	1		18	88	44
Limnephilidae					
<i>Ecclisomyia</i> sp.	1				
early larvae		1			
Rhyacophilidae					
<i>Rhyacophila</i> spp.					1
early larvae			2		
DIPTERA					
Ceratopogonidae	4		4		
Chironomidae					
Diamesinae	12	8	461	10	38
Orthocladiinae	102	101	948	32	16
Tanytarsini	4	8	61		
Empididae					
<i>Chelifera</i> sp.			45		6
Tipulidae					
<i>Dicranota</i> sp.			8		6
<i>Hesperoconopa</i> sp.			1		
<i>Limnophila</i> sp.			9		
Total taxa	22	22	31	19	27
Total individuals	2552	2650	6709	1016	1147

Site: Cardinal River u/s Nomad Ck			AB05DD0020		
Sample date & time:	12-Oct-95	10:15			
Sampling gear:	Neill cylinder (0.1 m2)				
Finest mesh size:	0.210 mm				
Collection by:	J. Willis				
Sorting and identification :	Emil Dratnal				
TAXA	Replicate sample				
	1	2	3	4	5
TRICLADIDA					
<i>Polycelis coronata</i>	2	11	1	3	7
NEMATODA	1		3		6
OLIGOCHAETA					
Enchytraeidae			2		
ACARI					
Stygothrombidiidae		2		2	
other	34	24	58	36	66
COPEPODA					
Cyclopoida	2		2		
OSTRACODA					
Candonidae					
<i>Candona</i> sp.	2	10	6	28	28
EPHEMEROPTERA					
Baetidae					
<i>Baetis</i> sp.	24	83	35	23	4
Ephemerellidae					
<i>Drunella doddsi</i>	3	10	10	6	8
<i>Drunella</i> sp.			1		
<i>Ephemerella</i> sp.			1		
early nymphs	51	76	56	74	48
Heptageniidae					
<i>Cinygmula</i> sp.	46	7	21	5	2
<i>Rhithrogena</i> sp.	20	14	20	9	12
early nymphs	319	367	291	333	166
Siphonuridae					
<i>Ameletus</i> sp.		6	16	22	26
PLECOPTERA					
Capniidae					
early nymphs	50	70	84	95	63
Chloroperlidae					
early nymphs	122	94	52	69	58
Leuctridae	37	31	29	38	35
Nemouridae					
<i>Zapada</i> sp.	29	68	49	43	23
Perlodidae					
<i>Isoperla</i> sp.		1	1		1
<i>Megarcys</i> sp.	1	1			
Taeniopterygidae					
<i>Taenionema</i> sp.	28	73	27	22	8
TRICHOPTERA					
Hydropsychidae					
<i>Parapsyche</i> sp.		4	2	1	
Rhyacophilidae					
<i>Rhyacophila</i> spp.	1	1	2		2
DIPTERA					
Chironomidae					
Diamesinae	1	5		1	
Orthoclaadiinae	9	20	18	8	14
Tanytarsini	1	6		1	2
Empididae					
<i>Chelifera</i> sp.	4	1	5	4	2
Tipulidae					
<i>Dicranota</i> sp.		3			2
<i>Hesperoconopa</i> sp.			5	6	2
Total taxa	22	25	26	22	23
Total individuals	787	988	797	829	585

Appendix I. List of taxa identified in zoobenthic samples, and zoobenthic laboratory methods.

A. List of taxa collected from the Cardinal Divide area in August and October, 1995.

Phylum, class or order	Family, subfamily or tribe	Genus, species
Tricladida		<i>Polycelis coronata</i>
Nematoda		
Nematomorpha	Chordodidae	
Oligochaeta	Enchytraeidae	
	Lumbricidae	
	Lumbriculidae	
	Naididae	
Acari	Stygothrombidiidae	unidentified
Cladocera		
Copepoda		
Cyclopoida		
Harpacticoida		
Ostracoda	Candonidae	<i>Candona</i> sp.
Collembola	Isotomidae	
Ephemeroptera	Baetidae	<i>Acentrella</i> sp. ^a <i>Baetis</i> sp. ^b <i>Drunella doddsi</i> <i>Drunella</i> sp. ^c <i>Ephemerella</i> sp. early nymphs ^d <i>Cinygmula</i> sp. <i>Epeorus</i> sp. ^e <i>Rhithrogena</i> sp. early nymphs ^f <i>Ameletus</i> sp. <i>Isocapnia</i> sp. early nymphs ^g <i>Alloperla</i> sp. <i>Neaviperla</i> sp. early nymphs ^h
	Ephemerellidae	
	Heptageniidae	
Plecoptera	Siphonuridae	
	Capniidae	
	Chloroperlidae	
	Leuctridae	
	Nemouridae	<i>Zapada</i> sp.
	Perlidae	<i>Hesperoperla pacifica</i>
	Perlodidae	<i>Isoperla</i> sp. <i>Kogotus</i> sp. <i>Megarcys</i> sp. early nymphs ^g <i>Taenionema</i> sp. ⁱ
Trichoptera	Taeniopterygidae	<i>Taenionema</i> sp. ⁱ
	Glossosomatidae	<i>Glossosoma</i> sp.
	Hydropsychidae	<i>Parapsyche</i> sp.

Phyllum, class or order	Family, subfamily or tribe	Genus, species
Coleoptera Diptera	Limnephilidae	early larvae ^j <i>Ecclisomyia</i> sp.
	Rhyacophilidae	early larvae ^g <i>Rhyacophila</i> spp. ^k Early larvae ^g <i>Heterlimnius</i> sp.
	Elmidae	
	Ceratopogonidae ^l	
	Chironomidae	
	Tanypodinae	
	Diamesinae	
	Orthocladiinae	
	Chironomini	
	Tanytarsini	
	Empididae	<i>Chelifera</i> sp. <i>Clinocera</i> sp. <i>Oreogeton</i> sp. <i>Pericomal Telmatoscopus</i>
	Psychodidae	
	Simuliidae	
	Tipulidae	<i>Dicranota</i> sp. <i>Gonomyodes</i> sp. <i>Hesperoconopa</i> sp. <i>Limnophila</i> sp.

Comments:

^a Former *Pseudocloeon*.

^b Probably all nymphs belong to *B. bicaudatus*.

^c Probably all nymphs belong to *D. coloradensis*.

^d *Ephemerella* and possibly *Serratella*.

^e Probably all nymphs belong to *E. (Iron) albertae*.

^f primarily *Cinygmula* and possibly some *Heptagenia*.

^g Early stages incompletely developed morphologically.

^h Early stages incompletely developed morphologically: *Plumiperla* and/or *Sweltsa*

ⁱ Immature nymphs of *Taenionema* (lacinia with a ventral comb of bristles; mandible with a small patch of inner hairs, far from molar ridge) which show some developmental phenomena resembling *Oemopteryx* (dorsal hairs at apex of cercal segments), which are probably lost in later instars. Opinion confirmed by Dr. Bill P. Stark (co-author of the major key to North American stoneflies.

^j Early stages incompletely developed morphologically, probably all *Parapsyche*.

^k *Rh. acropedes* gp., *Rh. alberta* gp. (former *Rh. tucula* gp.), *Rh. hyalinata* gp., *Rh. verrula* gp. and *Rh. vagrita* gp. Significant number of immature larvae.

^l Group of genera with a common type of larva.

B. Laboratory Methods.

SAMPLE PROCESSING

Sorting samples, preservation of sorted animals, identification and enumeration of invertebrates followed procedures recommended by Alberta Environment (1990) and Environment Canada (1993).

Benthic invertebrates were removed from accompanying debris using a dissecting microscope at 10x magnification. Rose Bengal stain was added to the samples first to improve sorting efficiency. Each sample was then separated into coarse and fine fractions by washing thoroughly through two sieves, with mesh sizes of 1000 µm and 180 µm. Each separated fraction of the sample was examined, portion by portion, on a gridded petri dish under the dissecting microscope, for removal of all benthos. Sorted invertebrates were stored in vials and preserved in 80% ethanol.

For large samples a fine fraction was subsampled, following the procedure by Wrona et al. (1982).

IDENTIFICATION

Identification was performed under dissecting and compound microscopes, and enumeration was carried out under the dissecting microscope. The results are presented in Tables 1 and 2.

QUALITY ASSURANCE/ QUALITY CONTROL

QA/ QC procedures were completed for sorting precision, identification accuracy and computer data entry.

Residues from four randomly selected samples was resorted by a person not involved in the first sorting. The sorting errors were 0.3%, 0.9%, 1.2% and 1.7% (Table 3), which allowed the assumption of a 95% recovery from all samples (Environment Canada 1993).

A reference collection of identified taxa was verified by Robert D. Saunders, qualified taxonomist independent of ECCON Environmental.

Total numbers of taxa and numbers of individuals per sample were calculated separately from rough data and from computer data, following data entry. Similar results ensured correct computer data entry.

REFERENCES

Taxonomy

- Brinkhurst, R.O. 1986. Guide to the Freshwater Aquatic Microdrile Oligochaetes of North America. Can. Spec. Publ. Fish. Aquat. Sci. 84. 259 pp.
- Clifford, H.P. 1991. Aquatic Invertebrates of Alberta. Univ. of Alberta Press. Edmonton, Alberta. 638 pp.
- Curie, D.C. 1986. An Annotated List of and Keys to the Immature Black Flies of Alberta (Diptera: Simuliidae). Mem. Ent. Soc. Can. 134. 90 pp.
- Edmunds, J.F. Jr., S.L. Jensen and L. Berner. 1976. The Mayflies of North and Central America. Univ. of Minnesota Press, Minneapolis. 330 pp.
- Larsen, D.J. 1975. The Predaceous Water Beetles (Coleoptera: Dytiscidae) of Alberta: Systematics, Natural History and Distribution. Quaest. Ent. 11: 245-498.
- Mackay, R.J. 1978. Larval Identification and Instar Association in Some Species of *Hydropsyche* and *Cheumatopsyche* (Trichoptera: Hydropsychidae). Ann. Ent. Soc. Amer. 71: 494-509.
- Mc Alpine, J.F., B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Fockeroth and D.M. Wood (Eds). 1981. Manual of Nearctic Diptera. Vol 1, Agriculture Canada. Monograph 27. 674 pp.
- Merritt, R.W. and K.W. Cummins (Eds). 1984. An Introduction to the Aquatic Insects of North America, 2nd ed. Kendall/Hunt Publ. Comp. Dubuque, Iowa. 722 pp.
- Moriyama, D.K. and W.P. McCafferty. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). Trans. Amer. Ent. Soc. 105: 139-221.
- Oliver, D.R. and M.E. Roussel. 1983. The Insects and Arachnids of Canada, Part 11. The Genera of Larval Midges of Canada. Diptera: Chironomidae. Agriculture Canada Publ. 1746. 263 pp.
- Pennak, R.W. 1989. Freshwater Invertebrates of the United States, 3rd ed. John Wiley and Sons, New York. 628 pp.
- Stamford D. Smith. 1968. The *Rhyacophila* of the Salmon River Drainage of Idaho with Special Reference to Larvae. Ann. Entomol. Soc. Amer. 61: 655-674.
- Stamford D. Smith. 1984. Larvae of Nearctic *Rhyacophila*, Part I: *acropedes* group. Aquat. Insects 1: 37-40.
- Stewart, K.W. and B.P. Stark. 1988. Nymphs of North American Stonefly Genera (Plecoptera). Thomas Say Foundation, Ent. Soc. Am., Vol. XII. 460 pp.
- Thorp, J.H. and A.P. Covich (Eds). 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, California. 911 pp.
- Wiederholm, T. (Ed). 1983. Chironomidae of the Holarctic region. Part 1, Larvae. Ent. Scand. Suppl. 19. 457 pp.

Wiggins, G.B. 1977. Larvae of the North American Caddisfly Genera (Trichoptera). Univ. of Toronto Press, Toronto. 401 pp.

General

Alberta Environment. 1990. Selected Methods for the Monitoring of Benthic Invertebrates in Alberta Rivers. Environmental Quality Monitoring Branch, Environmental Assessment Division. 41 pp.

Environment Canada. 1993. Guidelines for Monitoring Benthos in Freshwater Environments. EVS Consultants. 81 pp.

Wrona, F.J., J.M. Culp and R.W. Davies. 1982. Macroinvertebrate Subsampling: A Simplified Apparatus and Approach. Can. J. Fish. Aquat. Sci. 39: 1051-1054.

